A METHOD OF CALCULATING BROADBAND ACCESS SERVER DHCP USER'S ON-LINE TIME

FIELD OF THE INVENTION

5   The present invention generally relates to a method of time charging for a online user in a server in communication technology, and especially relates to an improvement of a method time charging for a DHCP online user in a broadband access server.

BACKGROUND OF THE INVENTION

10   With popularization of data services, there is little requirement of network knowledge for internet users.   An access mode of DHCP+WEB+RADIUS, because of its user-friendly interface and no requirement of sophisticated network knowledge for clients, is becoming a very popular network mode provided by telecom service providers.

DHCP, an abbreviation of Dynamic Host Configuration Protocol, allows a server to

15   dynamically assign an IP address and relevant configuration information of the server to a client.   For such a DHCP, each client can obtain an IP address at start and occupy the IP address thereafter, thus a DHCP access mode uses mass address resources of telecom service providers.   Furthermore, the DHCP access mode is unlike a narrowband access mode that can supply a man-machine interface with a perfect connection and disconnection mechanism.

20   At present, no flat rate of fee charging based on client's online time is available in the market, and only a monthly flat rate is used for the clients.   On one hand, it wastes a lot of communication resources.   On the other hand, with concerns on service level and return on investment, service providers demand urgently technologies of accurate timing to realize the flat rate for DHCP users.   When a DHCP user has been in an IDLE state for a period of time,

25   that is, when the user's communication data flow has been lower than an assigned value for a period of time, the user might be considered to be offline, and time charging for the user should be stopped.   In other words, it needs to detect a user's IDLE state.   Once the user is detected in the IDLE state, the user's connection with the network should be disconnected, and meanwhile time charging of user online should be ceased.   Therefore, login timing

30   accuracy to DHCP users relies on timeliness and accuracy of detecting the IDLE state.

Conventional detection methods of the IDLE state are in such way that a timer is

directly configured such that data flow of a user is detected periodically at each interval so as to decide whether an increment between the user's data flow and the last check point is less than a threshold (assigned value); if the increment is not greater than the threshold, the user is considered offline; otherwise, the user is considered online or downloading.

5   The conventional technology, however, has the following defects:

1. Due to inaccuracy of fee charging methods, a user in an IDLE state may be considered as in a normal online state.

For example, as shown in FIG. 1A, provided that a time interval for IDLE detection is about 5 minutes, a user has a great deal flow at the first minute, and the flow does not exceed

10   a threshold, the user will be forced to login off at the tenth minute according to a conventional algorithm.   Such detection error is certainly too large, and can also make a waste in communication resources.   To solve the problem, the time interval of detection is usually reduced in conventional methods for IDLE state detection.

2. Due to fixed time intervals, the state of a user may wrongly be detected.

15   For example, as shown in FIG. 1B, if the user's flow is relatively large at the fourth and the sixth minute, but such a flow is not large enough to exceed the threshold, the user will be forced to logoff at the tenth minute.   In fact, the user's flow at an interval of five minutes exceeds the threshold, and therefore the state of the user may wrongly be detected.   To solve the problem, testing time is usually increased in conventional methods for IDLE state

20   detection so as to reduce frequency of wrong detection.   Thus it is difficult for conventional methods to achieve a desirable precision for time charging to DHCP users.

Therefore, a heretofore unaddressed need exists in the art to address the aforementioned deficiencies and inadequacies.

25   **SUMMARY OF THE INVENTION**

The technical problem solved in the present invention is to provide a method of time charging to DHCP users in a broadband access server, which reduces detection error, solves the problem in detecting IDLE state and satisfies the accuracy required.

In one aspect, the present invention provides a method of time charging to DHCP

30   online users in a broadband access server, wherein the broadband access server detects data flow of an authenticated user by using an inner time interval that is shorter than an outer time

interval and a flow threshold and establishing a circular linked list corresponding to the user, and decides whether the user is in an IDLE state; if not, the server records the present flow value in the circular link list and continually detects the data flow; otherwise the server determines the user to be in an IDLE state. By reducing the time unit for data flow detection, the detection error is reduced, the problem of detecting an IDLE state is solved, and the required precision is satisfied.

In one embodiment, the method comprises the following steps:

a) setting an inner time, an outer time and a flow threshold for counting data flow of the users in the broadband access server, the inner time being shorter than the outer time;

b) starting time charging to the users by instruction of the access server to the users sooner after the users access the access server and are authenticated successfully,

c) establishing a circular link list to each user for recording data flow of the user in the access server;

d) defining a number of elements in the circular link list as a multiple of the outer time to the inner time in the access server; and

e) detecting the data flow of the user according to the inner time in the access server, and recording the data flow as a content of a head pointer of the circular link list in turn, until a difference between data flow newly detected and the content rerecorded in the head pointer is not more than the flow threshold.

The method is characterized in that, when the circular link list is not full, step e) further comprises the step of:

e1) examining data flow newly detected and the content of the head pointer, when the difference between the data flow newly detected and the content of the head pointer exceeds the flow threshold, saving the data flow newly detected as the content of the head pointer, and, meanwhile, moving the head and tail pointers down a position.

The method is characterized in that, when the circular link list is full, step e) further comprises the step of:

e2) examining data flow newly detected and the content of the head pointer

element, when the difference between the data flow newly detected and the content of the head pointer exceeds the flow threshold, saving the data flow newly detected as the content of the head pointer, and moving the head and tail pointers down a position.

5   The method is characterized in that the method further comprises the steps of:

f)   deciding the user in an IDLE state in the access server when the difference between the data flow newly detected and the content recorded in the head pointer does not exceed the flow threshold; and

g)   stopping time charging to the user by instruction of the access server to the user.

10   The method is characterized in that the method further comprises the step of setting the user in an unauthenticated state in step f).

The method is characterized in that the method further comprises the step of setting a charging server for time charging to the online users in step b).

The method is characterized in that the time for the charging server to stop time

15   charging is before an outer time corresponding to the inner time when the IDLE state is detected.

The method is characterized in that the inner time is about 30 seconds and/or the outer time is about 5 minutes.

In one embodiment of the present invention, the access server defines a circular link

20   list corresponding to a login user, regarding each element in the circular link list, the content of the head pointer records data flow that is detected in turn and when the assigned threshold is exceeded, and the tail pointer points to next element, so that data flow of the user can be monitored dynamically. In such a way, the time precision in detection is based on the inner time, and therefore detection precision is enhanced and detection error is reduced.

25   The technical solution and its advantage effects of the present invention will be obvious through describing of the preferred embodiments of the present invention in details below in combination with drawings attached.

BRIEF DESCRIPTION OF THE DRAWINGS

30   FIG. 1A and 1B are schematic diagrams of data flow detection of a conventional method.

FIG. 2 shows a flow chart of a method of time charging to DHCP online users in broadband access server according to one embodiment of the present invention.

FIG. 3 is a flow chart of detection for each inner detection period in a method according to one embodiment of the present invention.

5 FIG. 4 is a schematic diagram of data structure in a method according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A method of time charging to DHCP online users in a broadband access server

10 according to one embodiment of the present invention comprises the following steps:

Firstly, an outer time and an inner time are configured in a broadband access server for detecting an IDLE state, which corresponds to a logout state of a user. In general, the broadband access server always monitors user flow, where a unit of an interval (inner time) for monitoring the user flow in the broadband server is in seconds, and a unit of an interval

15 (outer time) for detecting an IDLE state at outside of the system is in minutes. According to one embodiment of the present invention, the interval for monitoring the user flow must be smaller than a time interval for IDLE state detection outside. For example, an outer detection time may be set to be about 5 minutes, a threshold is about 10k, a time interval for detecting the user flow within the system, namely inner time, is about 30 seconds. Referring

20 to FIG. 2, the time charging method for DHCP users is further described as below.

At step 110: a user automatically obtains IP address by DHCP, is authenticated successfully, and then accesses the Internet; and the access server timely informs a charging service to start time charging to the user accessed.

At step 120: the time charging starts from the time when the user is authenticated

25 successfully. In general, passing through authentication for the user indicates that the user starts to accept service provided by the service provider.

At step 130: the broadband access server calculates a number of elements in a circular link list based on the inner time and the outer time configured. The number of elements equals to the ratio of the outer time to the inner time. For example, in one embodiment, the

30 inner time is set to be about 5 minutes and the outer time is set to be about 0.5 minutes. Accordingly, the number of elements of the circular link list is the ratio of 5 to 0.5, that is 10.

The broadband access server then records the result calculated.

At step 140: the information on the user flow is timely updated.

At step 150: an IDLE state of the user is detected.

At step 160: the user in the IDLE state is forced to log out.

Referring to FIG. 3, the flow chart of detection for the circular link list is shown according to one embodiment of the present invention. The circular link list corresponds to an accessed and authenticated user. In a process of recording a corresponding user's data flow, a pointer is used to point a head pointer of the circular link list. The content of an element of the head pointer is corresponding to the value of flow before an IDLE detection interval, and the content of an element pointed by a tail pointer is the latest flow result detected.

The user's circular link list is not full when the user just passes the authentication. At first, whether the number of elements in the circular link list is up to 10 or not is checked. If the number of elements is not up to 10, an element is added at each interval of the inner time, the content of the head pointer is filled with data flow result reported, the element newly added is added to the tail of the circular link list, and the tail pointer points to the element new added. Particularly, each new data flow value is compared with the content of the head pointer in the circular link list, after compared, if the user is not in an IDLE state, such new data flow value is saved in the content of the head pointer. At the same time, the head and tail pointers move down one position, so as to ensure that the content of the element of the head pointer still is flow value before one IDLE detecting interval and the content of the element pointed by the tail pointer still is the latest data flow result detected.

If the circular link list is full (up to 10), new data flow value detected is compared with the value of the element of the head pointer; if the difference between the new data flow and the content of the element of the head pointer is greater than the assigned threshold, 10k for example, the new data flow value overwrites the value of the head pointer, and meanwhile, the head and tail pointers move down one position, so as to ensure that the value of the element of the head pointer still is the flow value before one IDLE detecting interval and the value of the element pointed by the tail pointer still is newly data flow result detected.

If the difference between the new data flow and the content of the element of the head pointer is not greater than the assigned threshold, 10k, the user is considered being offline;

and then the broadband access server sets the user in unauthenticated state, that is, the user is forced to logout.   Meanwhile, the broadband access server informs RADIUS Server of the user being offline and stopping time charging.   The time when the user logs out is considered as the time before 5 minutes.

5   In the embodiment, as shown in FIGS. 2 and 3, the broadband access server starts to query the user's data flow.   Referring back to FIG. 3, detection for the circular link list includes the following steps: at step 300, the number of elements in a corresponding circular link list is obtained by detecting the user's data flow.   At step 310, the number of elements is compared with those in the current circular link list.   Then at step 320, whether a desirable

10   number of elements is achieved is determined.   If not, the detection result is filled to the content of the head pointer and the tail pointer point is made to the new element, meanwhile, the head and tail pointers move down one position, and data flow is detected for a next inner time at step 340.   If the number of elements in the circular link list is greater than the desirable number, the element of the tail pointer and the content of the head pointer are

15   compared at step 330.   Then whether the difference between the element of the tail pointer and the content of the head pointer is greater than the assigned threshold is determined at step 350.   If the difference is greater than the assigned threshold, the head and tail pointers are moved down one position, and the new data flow is filled to the content of the head pointer at step 360.   If the difference is not greater than the assigned threshold, the user is set to be in

20   unauthenticated state and forced to offline by the broadband access server at step 370.   Then the system is returned to its detection state at step 380.

In one embodiment of the present invention, the detected results of the data flow of the user in the latest period of time are saved in turn, which corresponds to a queue of the user's flow data observing through a data window in which the width of the data window is width of

25   the inner time for detecting flow assigned for the user.   In the data window, multiple detecting results are saved, and the interval of each result is corresponding to the inner time for detecting flow in the system, as shown is FIG. 4.

Accordint to the present invention, when the data flow of the user is queried once, the data window goes forward one position.   While moving, the flow results at the two ends of

30   the window are compared; if the difference between the flow results at the two ends of the window is not greater than the threshold, the user is considered in an IDLE state and forced to

be offline; otherwise, new data detected is filled into the content of the head pointer.

In conventional algorithms for realizing IDLE detection, in general, the granularity of detection is an interval assigned for detecting, such as 5 minutes. However, according to the method (algorithm) of the present invention, the detection granularity is the inner time for querying user data flow in the system, such as 30 seconds, so the detection is more accurate.

It should be noted that the inner time and the outer time in the method of the present invention could be assigned in different values. The specific value mentioned above is corresponding to one embodiment of the present invention, which should not be used to limit the scope of the present invention.

It should be noted that, persons skilled in the art should understand that, the technical solutions of the present invention can be modified or substituted, without departing from the spirit and scope of the present invention, and all the modification and substitution fall in the scope of claims in the present invention.